

FROM THE GREEN REVOLUTION TO THE GENE REVOLUTION: WHY GROWTH AND POVERTY COEXIST IN PAKISTAN

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ABSTRACT

Agricultural biotechnologies, long exalted as the engine of economic growth, are now being held up as the ultimate answer to mass hunger. Norman Borlaug, founder of the green revolution, even called for the Gene Revolution to feed the world (Borlaug, 2001; 2000a; 2000). Pakistan, apparently receptive to such calls, is ready to leap into the Gene Revolution and corporate farming (Ahmed, 2003). Growth and growth technologies, however, had little ameliorative impact on hunger, poverty or unemployment in Pakistan. This paper argues that the green revolution foundered on the structural inequalities in Pakistan, which are likely to dog its future turn to the Gene Revolution also. It is, therefore, imperative that Pakistan aggressively address structural inequalities in order for agricultural biotechnologies to succeed in easing poverty and hunger. In the face of distributional inequalities, structuring of an entitlement program, as persuasively argued by Amartya Sen (1982), is all the more urgent.

INTRODUCTION

Pakistan embraced the green revolution in the 1960s to work its way out of radical alternatives, such as land redistribution from the landed nobility to the landless masses (Alavi 1976, Jalal 1990). The green revolution and its technologies (i.e., high-yielding seed varieties, fertilizers, pesticides, irrigation, farm mechanization) were hoped to end hunger, rendering land redistribution unnecessary. Its founder, Dr. Norman Bourlaug, spotlighted the green revolution for the same rationale – end of hunger (Borlaug 2000, 1972, Borlaug and Doswell 2001). The green revolution has since set Pakistan on a high-growth trajectory, which swelled its agricultural production, and in turn its Gross Domestic Product (GDP). Yet the surge in agricultural

production, with parallel economic expansion, did not live up to the green revolution's promise of ending hunger.

Consequently, the most recent evidence on food security in Pakistan presents a depressing picture. In 2011, the World Food Program (WFP) found that malnutrition was hitting 21% to 23% of the population in rural Sind (Dawn, March 23, 2011), which ironically is one of the country's two provinces that are most endowed with agricultural riches. It is noteworthy that the WFP declares 'food emergency' if 15% of a country's population is malnourished. A year earlier, in 2010, the government of Pakistan itself estimated that 15.7% of its population was malnourished, while 58% of it bordered on malnutrition (Dawn, June 2, 2010). *It must be noted that the government reported on nation-wide malnutrition well before the devastating floods hit the country in the summer of 2010.* The specter of malnutrition is accompanied by the growing national poverty rate that has risen to 36.1% in 2008–09 (GOP 2010).

Earlier the World Bank (2002) reported that one in every three Pakistanis was living in poverty, i.e., lack of material and financial resources to meet one's biological needs. Other international institutions (see e.g., IMF 2004, UNDP 2003) also confirmed these trends. The World Bank (2002), however, found rural poverty even worse, as two in every five country dwellers lived in poverty. On the other hand, many observers (Byerelee and Ali 2000, Byerlee and Siddiq 1994, Faruqee 1999, 1995, Murgai et al. 2000) have noticed ecological fatigue that they argue has begun to cause a decline in agricultural productivity (i.e., decline in output per unit of farm input). If farm productivity begins to fall, the hope for easing poverty and ending hunger will further diminish.

Paradoxically malnutrition and poverty continue to persist despite the spectacular success of the green revolution that also powers Pakistan's national economy. As an agrarian society, Pakistan's agriculture sector, directly or indirectly, sustains its manufacturing and service sector economies also. As much as 70% of the country's exports are made up of primary or processed products of the agriculture sector, of which textile takes pride of place. Given the above, it is unsurprising that the green revolution's contribution to Pakistan's national economy gains greater scholarly attention, but its social impact is relatively brushed aside. The insufficient attention to its social impact needs to be addressed to have a balanced empirical account of the green revolution and its contemporary evolution into the Gene Revolution.

This paper is an attempt to fill this need, which speaks to the economic and social impact of the green revolution since its debut in Pakistan in the mid-1960s. To conduct such an inquiry is important for

additional three factors: First, there is a renewed interest in Pakistan to pursue even more advanced agricultural biotechnologies for genetic manipulation of food and cash crops. Driven by this interest, the government has of late turned its attention to corporate farming (Ahmed 2003). Second, advanced agricultural biotechnologies failed to address the interests of the small and subsistence farmers, who constitute 95% of the farming population in Pakistan (GOP 2000a, 1990). Instead, they tend to favor agricultural business enterprises and large landholders.

In pursuit of such technologies, Pakistan has already ruled out land reforms (Ahmed 2003), which a World Bank study (World Bank 2002) pushes as the only way to stem the rising tide of poverty in rural Pakistan, especially among landless rural residents. Third, many multinational institutions such as the Food and Agricultural Organization (FAO, 2004) and corporations (see e.g., Kloppenburg 1988, Ruttan 1999) have been advancing the cause of genetically enhanced food production to end mass hunger in the developing world, despite skeptics' (e.g., Kloppenburg 1988) arguments to the contrary. The founding father of the green revolution, Dr. Borlaug, lent his own voice to this cause on two counts: Genetically enhanced crops would end hunger and save natural resources such as land and water by growing more food from fewer acreage and less irrigation (Bailey 2000, Borlaug 2000, Borlaug and Doswell 2001).

Pakistan is thus set on a course to the *Gene Revolution*, primarily for its putative economic and social benefits. Five decades ago, Pakistan embraced the green revolution for the same logic – economic and social benefits. To better inform Pakistan's planned leap into the Gene Revolution, it is worth the effort to carefully analyze the economic and social impact of the green revolution. Based on empirical evidence from Pakistan, this paper argues that the social cost of the green revolution, an early form of agricultural biotechnology, outweighs its economic benefits. Social cost is evident in mass hunger, widespread poverty, rising unemployment and depeasantization. What follows is an account of the economic and social impact of the green revolution, which is divided into five sections. Section I above lays out the foundation of the inquiry. Section II will establish the theoretical linkages between the growth approach and the green revolution. Section III and IV will respectively provide evidence on the economic and social impact of the green revolution. Section V will discuss the evidence and offer major conclusions.

II. THE GROWTH APPROACH AND THE GREEN REVOLUTION

The literature on the green revolution deploys economic growth as the ultimate measure of its success. The proponents of the green revolution define growth as quantitative increases in resource productivity (Hazell and Ramaswamy 1991). While accentuating its economic contribution, the growth approach tends to minimize the green revolution's social costs by blaming them on mismanagement of technology rather than technology itself, i.e., the green revolution (see e.g., Borlaug and Doswell 2001, Hazell and Rosegrant 2000, Murgai et al. 2000, Singh 2001). Instead, it highlights productivity gains spurred by the green revolution.

Economic Productivity

The growth approach views the green revolution as one that has unlocked the immense potential for productivity in natural resources such as land. Authors in this tradition (Borlaug 2000, Borlaug and Doswell 2001, David and Otsuka 1994, Fan et al. 2000, Hazell and Fan 1998, Hazell and Ramaswamy 1991, Hazell and Rosegrant 2000, Sharma and Poleman 1993, Singh 2001) argue that malnutrition, income distribution, and ecological degradation would have been worse without the green revolution. The primary objective of the green revolution was to end hunger in Asia and Latin America (Borlaug 1972, Lionaes 1972) through a widespread introduction of high-yielding seed varieties (HYSVs) of food crops such as maize, rice and wheat (Hazell and Ramaswamy 1991). These HYSVs and associated technologies (i.e., chemical fertilizer, artificial irrigation, pesticides, farm mechanization) later came to be known as the green revolution. Since the introduction of such varieties, the production of food has, indeed, grown manifold (Borlaug 2001, 2000, Hazell and Rosegrant 2000, Murgai et al. 2000, Singh 2001).

This growth has come through a surge in productivity, i.e., output per unit of land and labor, and increase in production, i.e., output per total cropped area (Murgai et al. 2000, Hazell and Ramaswamy 1991). Had the traditional methods of cultivation were not modernized, Hazell and Ramaswamy (1991) argued, hunger would still be with us. The advent of the green revolution was thus billed as the Asian miracle that had saved the world's largest continent from famine and starvation (Hazell and Rosegrant 2000). Das (1998) concludes that there is near consensus among scholars that the green revolution did boost farm productivity. Most recent defender of the green revolution's growth dividend was no other than its founder, Dr.

Borlaug. He attributed continued surges in food production to such technologies as high-yielding seed varieties (Borlaug and Doswell 2001; 2000).

Mass Employment

The earlier proponents of the green revolution (Black 1960, Brown 1970, Lionaes 1972, Mellor 1970) were no less enthusiastic about its growth potential. They saw in it a way out of poverty and malnutrition (Black 1960), rural unemployment (Brown 1970, Mellor 1970), and income inequalities (Lionaes 1972). Of all its early proponents, Brown (1970) was the most euphoric about the vistas of opportunities the green revolution was going to open up. He spotted in HYSVs an engine of growth and placed his fervent hopes on agricultural intensification as a generator of mass employment. He went so far as to predict labor shortages in areas of adoption of the green revolution. Barker and Herdt (1984) confirmed these expectations in their findings that HYSVs had actually raised the per acre/year labor demand by one-fifth. Similarly, Sharma and Poleman (1993) reported that the green revolution generated widespread employment opportunities in post-harvest operations such as storage, milling, marketing and transportation.

Falloff in Poverty

Many others (Lipton and Longhurst 1989, Sharma and Poleman 1993) found that agricultural intensification helped raise rural incomes. David and Otsuka (1994), in their study on the impact of HYSVs in seven Asian countries of Bangladesh, China, India, Indonesia, Nepal, the Philippines and Thailand, concluded that the green revolution prevented significant disparities in income distribution through increased real wages, decline in consumer price of rice, and security in land tenure. Hazell and Fan (1998) confirmed that increased agricultural productivity had reduced poverty in India by increasing farmer income, higher work wages, and reduced agricultural consumer prices. Similarly, Lin (1998b), in his study of 500 households in Hunan province of China, demonstrated that the negative impact of the new technology on equity was minimal. Fan et al. (2000), on the other hand, discovered that rural poverty in India actually substantially declined as a result of public investment in the agricultural sector.

Proponents of the growth approach also credit the green revolution for saving natural resources and the environment in general (Borlaug 2000, Borlaug and Doswell 2001, Gill 1995, Harrington,

1983, Hazell and Rosegrant 2000). Green revolution, by virtue of increased food output, they argue, reduced the need for opening up more land for agriculture, especially in the fragile agricultural ecosystems (Hazell and Rosegrant 2000), which would have led to massive deforestation (Borlaug 2000, Borlaug and Doswell 2001). Without the green revolution, 60% more land would have been needed to feed the present population at the current rate of nutritional supplies (Gill 1995). Borlaug and Doswell (2001) estimate that the world, without the green revolution, would have needed additional 1.2 billion hectares of land to produce the global harvest of 1998. With the green revolution, they claim, 600 million hectares produced what 1.8 billion (600 m ha + 1.2 billion ha) hectares would have produced without it.

Structural Inequalities and Vertical Accumulation

The growth approach, however, failed to recognize structural barriers to the distribution of dividends from increased productivity. Its early proponents assumed that respective states would manage the task of distribution (Borlaug 1972, Lionaes 1972). The succeeding generation of authors (e.g., Hazell and Ramaswamy 1991, Sharma and Poleman 1993) argued that increasing vertical accumulation would eventually produce enough surplus to flow downward to the masses. Both assumptions – of state agency and trickle-down effect – were flawed for at least one singularly important omission: structural inequalities in the ownership of key productive resources such as land and capital (Griffin et al. 2004). With such structural impediments in place, growth dividends were more likely to accrue to those who had owned the land and capital (Cleaver 1972, Fairbairn 1995, Kuhnen 1996). As a result, not only had green revolution technologies caused the concentration of land and capital to further deepen (Cleaver 1972, Kuhnen 1996), but they also helped create a mass of landless peasants and penurious farmers (Griffin et al. 2004).

Similarly, optimism about employment generation equally proved ephemeral (Cleaver 1972, Das 1998, Fairbairn 1995, Kuhnen 1996). Brown (1970) who had envisioned labor shortages due to agricultural intensification and farm mechanization had seen farm jobs disappear as mechanical power came to replace manual labor (Kuhnen 1996). In areas where job growth did take place, it was unevenly spread across regions. Das (1998), in his comparative study on two Indian states, found that job growth was concentrated in areas endowed with such key productive resources as fertile land and irrigation supplies. As naturally endowed areas were short in supply, India's regional disparities in job growth deepened as a result (Das 1998). The trickle-down effect of regional and vertical accumulation,

thus, failed to materialize to help the needy masses of peasants, whose access to productive resources was either reduced or completely eliminated (Kuhnen 1996). More importantly, the bias of riches inherent in the capital-intensive technologies of the green revolution (Fairbairn 1995) priced capital-poor farmers out of farming (Cleaver 1972, Kuhnen 1996), and uneven agricultural development across regions caused wages to drop (Das 1998). These were structural barriers that the growth approach and its proponents chose to ignore in the fond hope that the tide of the green revolution would lift all boats.

Green Revolution and Pakistan

Pakistan, which Dr. Borlaug showcased as his success story and which he used as a launching pad for the green revolution (see Borlaug 2000, Borlaug and Doswell 2001), however, tells a different story. As will be spelled out below, the green revolution helped Pakistan to move from being a food-deficit country to become a food-surplus nation in the 1980s, albeit briefly. The country has since relapsed into food shortages (GOP 2003). Future forecasts of food-deficit are even more fraught, despite occasional surplus production. Byerlee and Siddiq (1994), for instance, predicted that Pakistan would become a major food importer in the next two decades. This prediction has already begun to cast its shadow on Pakistan's annual food import bill that has grown to \$5 billion (404 billion rupees) in 2011 (Jang, July 2, 2011). At \$5bn, food imports constitute one-fourth of Pakistan's revenue and one-sixth of its annual budget of \$32 billion (GOP 2011).

Despite its contested success in food production, Pakistan has seen the problem of hunger and absolute poverty worsened (Dawn 2011 2010, IMF 2004, UNDP 2003, World Bank 2002), as dividends of the green revolution continued to concentrate upwards and failed to trickle down as assumed by the proponents of the growth approach. Policies based on the trickle-down assumption, as a result, could not widen the access of the downtrodden masses to land and capital (Griffin et al. 2004), thus further exacerbating the problem of rural poverty. Yet in pursuit of economic and farm growth, Pakistan also has suffered widespread damage to its most productive land base (for a detailed account of ecological degradation in Pakistan, see IUCN 2000 1992, Niazi 2006).

Analyzing the economic and social impact of the green revolution, this paper argues that the bias of riches inherent in agricultural biotechnologies, beginning with the green revolution (Cleaver 1972), will continue to enrich the rich and impoverish the impoverished, unless a deliberate effort is mounted for equitable distribution of key productive resources, especially farmland and/or

growth dividends. To advance this argument, this analysis will focus on the economic and social impact of the green revolution.

The economic impact here will be assessed in farm growth and its second-order effect on the country's gross domestic product (GDP). The social impact will be assessed in (a) mass hunger, (b) growing poverty, (c) rising unemployment, and (d) depeasantization. The quantitative data employed here primarily come from government sources such as the Census of Agriculture Organization, Federal Bureau of Statistics, the Finance Division of the Government of Pakistan, and the Planning Commission of Pakistan. The government of Pakistan draws upon these data gathering agencies to compile its flagship publications such as the *Economic Surveys* and their *Statistical Supplements* that are brought out ahead of the presentation of annual federal budgets.

Besides, I have made extensive use of agricultural and economic data compiled by such multilateral institutions as the United Nations Development Program (UNDP), World Bank, International Monetary Fund (IMF), Food and Agricultural Organization (FAO) and World Food Program (WFP). Last but not least, I have trawled print and electronic media for anecdotal and statistical information on social deprivation, especially hunger, malnutrition, poverty and unemployment. Pakistan's news organizations have, of late, engaged a range of issues related to social development, and reported a wealth of information that constitutes primary sources. The electronic media, which consists of around 100 television channels, has made its debut in the early 2000s. Its emergence has intensified the engagement with issues of economic and social development. It regularly features highly informative programs studded with top bureaucrats, development experts, government leaders, politicians and activists. I have drawn upon all these sources to answer the question why growth and poverty coexist in Pakistan.

III. THE ECONOMIC IMPACT OF THE GREEN REVOLUTION

The green revolution was launched to boost Pakistan's food, farm and national economies. In terms of the food economy, Pakistan's biggest challenge was the low crop yield that was not keeping up with the growing food needs of the national population. The green revolution deployed breeding technologies to augment plant yield. Pakistan's two premier research institutions were initially enlisted to advance HYSVs through plant breeding. Pakistan's renowned Agricultural University of Faisalabad (AUF), which was

founded in the early 20th century by the British government of India, was in the lead to bring this initiative to fruition. In the heyday of Pakistan's agricultural production, the AUF was headed by an Oxford-trained molecular biologist, Dr. Amir Muhammad. Later, Dr. Amir (as Muhammad is not a surname, most Pakistanis, and Muslims in general, are referred to by their first name as their last name, such as Dr. Amir instead of Dr. Muhammad) was chosen to restructure Pakistan's flagship research organization, Pakistan Agricultural Research Council (PARC) to bring farm research to the farm-gate. Dr. Amir was friends with Dr. Borlaug, and both came to be known as co-founders of the green revolution in Pakistan. The early efforts were thus aimed at altering plant growth and accelerating Pakistan's food production through farm biotechnologies.

Before green revolution technologies were introduced in the country, Pakistan was gripped by frequent famines and chronic food shortages. The green revolution and its allied technologies have since tremendously lifted Pakistan's crop yield, especially the yield of its food crops, such as wheat and rice. Wheat is Pakistan's staple, while rice is largely a cash crop, although it is the mainstay of diet in parts of Pakistan. With the application of green revolution technologies, wheat and rice yield has multiplied several times. As is evident from Table 1 below, wheat yield has more than tripled from 801 kilogram per hectare in 1959–60 to 2,657 kilogram per hectare in 2008–09. The rising wheat yield translated to burgeoning food production, which has grown six-fold from a meager 4 million tons in 1959–60 to 24 million tons in 2008–09. This trend in growth continued into 2011, when Pakistan had a harvest of more than 24 million tons of wheat (GOP, 2011). The land area planted with wheat almost doubled from 4.9 million hectares in 1959–60 to 9 million hectares in 2008–09.

Table 1
Growth Pattern in Food Crops: 1959–60 to 2009–10

Year	Wheat			Rice			Total Food Grain	
	Yield (Kilogram/hectre)	Production (Million Tons)	Area (Million Hectres)	Yield (Kilogram/hectre)	Production (Million Tons)	Area (Million Hectres)	Production (Million Tons)	Area (Million Hectres)
1959-60	801	4	4.9	826	1	1.2	N/A	N/A
1990-91	1,841	14.5	7.9	1,543	3.2	2.1	19.5	11.9
19995-96	2,018	16.9	8.37	1,835	3.9	2.1	22.9	12.4
2000-01	2,325	19	8.1	2,021	4.8	2.3	25.9	12.3
2005-06	2,519	21.2	8.4	2,116	5.5	2.6	30.3	12.8
2007-08	2,451	20.9	8.5	2,212	5.5	2.5	31.9	13
2008-09	2,657	24	9	2,346	6.9	2.9	35.1	13.8
2009-10p*	2,639	23.8	9	2,387	6.8	2.8	34.7	13.6

Source: Multiple data sets from GOP (2010); Niazi (2004)

* 1 Hectre = 2.47 Acres

In parallel, rice yield jumped from 826 kilogram per hectare in 1959–60 to 2,346 kilogram per hectare in 2008–09, an increase of 280%. With boost in yield, rice production leaped seven times from its

base of 1 million tons in 1959–60 to 6.9 million tons in 2008–09. The land area planted with rice more than doubled from 1.2 million hectares in 1959–60 to 2.9 million hectares in 2008–09. As a result, the total foodgrain production, including but not limited to wheat and rice, increased by 170% just over the past two decades. It went up from 19.5 million tons in 1990–91 to 35 million tons in 2008–09. Yet the land area under food crops has registered a relatively meager increase, over the same period, from 11.9 million hectares in 1990–91 to 13.8 million hectares in 2008–09. The tremendous growth in the food economy paralleled with the equally impressive growth in the overall agricultural economy, which peaked in the 1980s and has since been on a downward trajectory, however. With the onset of the green revolution, the farm economy maintained an annual average of 5.1%.

Table 2
Trends in Ag Growth in Pakistan

Years	% of Age Growth
1960s	5.1
1970s	2.4
1980s	5.4
1990s	4.4
2000s	3.2

Source: GOP (2010)

By the end of the 1960s, when the green revolution began to yield gains in productivity, Pakistan's economy posted the highest agricultural growth rate since the country's independence in 1947. As Table 2 above shows, the 1960s' rate was rivaled only by that of the 1980s, when agricultural growth peaked to the highest-ever rate of 5.4% a year. The intervening decade of the 1970s was a disaster, which was largely caused by devastating floods and repeated crop failures. For the first time, Pakistan was introduced to rationed food, especially the rationing of wheat and wheat flour. Food scarcities that marked the 1970s eventually hastened the tragic fall in 1977 of Pakistan's otherwise charismatic leader Zulfikar Ali Bhutto. Since the 1980s, Pakistan's farm economy has been consistently trending down. The decade of the 1990s fared poorer than the 1980s and the 2000s ended up even poorer than the 1990s. Yet the agricultural growth rate kept ahead of Pakistan's population growth rate. Even in the 2000s, when agricultural growth dropped to the lowest-ever rate of 3.2% a year, it was still 1.2% higher than the country's birth rate of 2.05%.

Table 3
World-Wide Yield Gap of Wheat and Rice (in Kgs): 2008

Country	Wheat		Rice Paddy	
	Yield	% of best yield	Yield	% of best yield
World	3,086	65	4,309	44
China	4,762	100	6556	67
Egypt	n/a	n/a	9,731	100
India	2,802	59	3,370	35
Pakistan	2,451	52	3,520	36
USA	3,081	63	7,672	79

Source: Multiple Data Sets of GOP (2010)

Although wheat and rice yield has grown by 300% and 280% respectively since 1959–60, this growth still represents only a fraction of the realizable yield potential for these crops. As Table 3 above shows, Pakistan's yield for wheat is only half (52%) of China's that is the world's highest at 4,762 kilogram per hectare. Pakistan's rice (paddy) yield is even poorer at 36% of Egypt's 9,731 kilogram per hectare that is rated the best in the world. Pakistan is now turning to advanced agricultural biotechnologies, especially genetic manipulation of food crops to bridge the yawning gap in yield. It has already successfully experimented with the genetic enhancement of cotton, which is now known in Pakistan as Bt cotton (i.e., biotech). In 2011 alone, eight new varieties of Bt cotton have been introduced (Crossfire, April 28, 2011). On the other hand, Pakistan is moving cautiously on the genetic manipulation of food crops for reasons of health concerns.

Contrarians, however, believe that the yield gap is unbridgeable because Pakistan, in their view, has already reached its productivity limits (Faruqee 1999 1995). Given that 94% of Pakistan's farmland is deficient in organic matter (IUCN 1992), which is essential for plant growth, the challenge of depleting soil nutrients is ever more compounding. If the ecological fatigue of Pakistan's soils sets off a decline in farm yield and farm production, its adverse effects will ripple throughout the national economy that closely feeds off the farm economy. Pakistan's farm and national economies historically have been inextricably linked. A case in point is Pakistan's export economy, which is dominated by cotton and cotton-based textile products. The textile component alone accounts for 55% of the country's annual exports and employs 38% of the entire workforce (China Post, April 11, 2011).

Future growth in cotton production is likely to further cotton's already dominant role in the export economy. Its current production is 12 million bales a year. In financial terms, each million bales adds

\$1 billion to the national economy (Express, May 29, 2011). There is potential to raise cotton production to 20 million bales a year, which will add additional \$8 billion to the national economy (Express, May 29, 2011). Cotton's impact on the national economy can be further gauged from a mushroom growth in cotton-based industries since Pakistan's independence. In 1947, when Pakistan became independent, it had 14 ginning factories that have grown to 1,200 in 2011 (Express, June 11, 2011). In the like vein, textile mills have grown from just two to 521 in 1947–2011.

Since the launch of the green revolution, Pakistan's national economy has been on a course to upward mobility. Pakistan's GDP has grown more than seven-fold just in the past three decades from \$28.6 billion in 1980 to \$210 billion in 2011 (GOP 2011). The country's per capita income has grown to \$1,254 in 2011 (GOP 2011). The IMF, in its Global Monitoring Report 2011, has placed Pakistan, among the "lower-middle income" countries of the region, which include, besides Pakistan, Bhutan, India and Sri Lanka (Dawn, April 16, 2011). Measured in strictly primary products, the agriculture sector's share in the country's GDP is the second largest (21%) after the service sector (GOP 2010). Yet the agriculture sector, in the government's reckoning, continues to be the single-largest employer with 45% of the country's labor force engaged in the farm sector (GOP 2010). Such claims, however, are inconsistent with the findings of independent researchers such as Adams (1993) who found 65% of rural residents in Pakistan unemployed or underemployed.

IV. THE SOCIAL IMPACT OF THE GREEN REVOLUTION

The economic contribution of the green revolution, as recounted above, manifestly attests to the increased resource productivity that it spurred (Hazell and Ramswamy 1991, Murgai et al. 2000). As a result, Pakistan's food, farm and national economies have registered tremendous growth. Although experts are divided on how long this growth can be sustained, the immediate forecasts brim with optimism. The question, however, is whether this economic growth has made any dent in mass hunger, widespread poverty, rising unemployment and growing income disparities as predicted by the proponents of the green revolution. It must be noted that these proponents' predictions were based on what turned out to be questionable assumptions that the green revolution would lift all boats and that cumulative growth would trickle down to the lower reaches of society.

Hunger, Malnutrition and Underconsumption

In retrospect, this trickle-down effect was thought to be autogenous, which rendered any distributive concern unnecessary. All that mattered was growth, which was naively thought to direct itself to the needy without effort. Hazell and Ramswamy (1991) made an evocative argument in defense of growth by equating more of it with less of hunger. They wrote that if the traditional methods of cultivation were not modernized, hunger would still be with us. Decades ago, Borlaug (1972) and Lionaes (1972) actually defined the primary objective of the green revolution as an end of hunger in Asia and Latin America. This objective was to be realized through widespread injection of HYSVs of such crops as maize, rice and wheat (Hazell and Ramswamy 1991). Many others argued that malnutrition, income distribution and ecological degradation would have been worse without the green revolution (Borlaug 2000, Borlaug and Doswell 2001, Fan et al. 2000).

Pakistan, on the contrary, has seen hunger, malnutrition and poverty worsened since the green revolution took roots in the 1960s, and elevated the country's growth to its highest level since its independence in 1947. Even five decades after, when Pakistan is ready to launch into the Gene Revolution, the end of hunger is still a distant blip on the horizon. Irony is that hunger and malnutrition exist in the midst of growth and plenty. In March 2011, the WFP alarmed the country with its report that malnutrition had afflicted 21% to 23% of the population in the Sind province of Pakistan (Dawn, March 24, 2011). At this scale, malnutrition in Pakistan is higher than that of Africa. If 15% of a country's population is found malnourished, the WFP declares food emergency, i.e., sending out appeals to world nations for emergency assistance in cash and kind to ease the challenge.

As the WFP, in another report, pointed out, a large section of Pakistan's population was suffering from underconsumption (Dawn, June 2, 2010). According to this report, Pakistan consumed 18 million tons of wheat in 2009 as compared to the normal consumption of 20 million tons (Dawn, June 2, 2010). The surplus wheat was exported to earn foreign exchange, of which Pakistan is often in need.

The WFP's report was preceded by the government of Pakistan's own assessment of hunger in 2010. According to this assessment, 15.7% of the country's population was malnourished and 58% of it bordered on malnutrition (Dawn, June 2, 2010). *The reader may be tempted to attribute this malnutrition to the destruction wrought by the flash floods in the summer of 2010. But, alas, that is not the case. The government conducted and reported its assessment of*

nation-wide malnutrition long before the devastating floods hit the country. Irony here is that the worsening malnutrition was afflicting the country particularly when its warehouses were bursting with surplus grain, and its farm fields were producing more than the country could consume. Just this year (2011), the government reported a bumper harvest of 24.2 million tons of wheat (GOP 2011) that exceeds the nation's consumption needs by over 4 million tons.

This discrepant situation of privation in the midst of plenty starkly points to the fallacy of the growth approach that simple "availability" of foodgrain would fill the hungry stomachs on its own. The growth approach and its proponents, wittingly or unwittingly, disregard the concern for the "affordability" of foodgrain. Their argument that once food is available, the state will ensure to supply it to its citizens proved hollow. On the contrary, the state in Pakistan became the largest trader in foodgrain and cash crops. Also, the state wields its power to fix foodgrain prices, often to the advantage of largest growers. In 2011, the government determined highest-ever prices for wheat that benefited a well-connected cartel of 6,000 largest wheat growers, who pocketed 200 billion rupees, about \$2.3 billion in U.S. dollars (Capital Talk, June 3, 2011). The state sells the purchased foodgrain, especially wheat, at much higher rates in the international market, with an apparent aim to earn foreign exchange to replenish its ever-drying reserves. As a result, those who cannot buy food for lack of financial wherewithal are forced to cut back on their consumption. The consequent malnutrition or hunger from underconsumption is changing the biological make-up of Pakistan's younger population.

Of all regions, malnutrition and biological diminution are most visible in southern Punjab, which ironically is the breadbasket of Pakistan. Malnutrition is marking this region with stunted growth in children, who are growing up to adulthood at a height that is far shorter than the normal (average) height of adults in the region (Khabarnak, April 3, 2011). Travelers to southern Punjab cannot help but notice adolescents of unusually short stature. Experts believe that hunger and malnutrition lie at the core of diminishing humans who find food prices beyond their reach (Khabarnak, April 3, 2011). The issue of food affordability is exacting its toll in even more heart-wrenching ways. In just two towns, Kotmomin and Sargodha – which each sit at the intersection of south and central Punjab – 10,000 residents have gone under the knife to have their organs surgically harvested to sell them for buying food and paying off loans (News, April 13, 2011). Food cost for the working and lower middle classes is way too high. According to some experts who study this issue, Pakistanis spend 87% of their income on food (Khabarnak, April 3, 2011). The government's own estimates are not far from this

projection. The bottom 20% of the population in Bangladesh spends as much as 69.3% of their income on food, which the government of Pakistan accepts “as a fair proxy for Pakistan” (GOP 2010, pp. 134).

Widespread Poverty

Interestingly, poverty and hunger are not two divergent concepts in Pakistan. Both are defined in terms of unavailability of food. The poverty line is drawn at an adult’s daily calorific intake, the price of which serves as its financial equivalent. The government’s economists determine the poverty line on the assumption that an adult consumes 2,350 calories per day. The financial proxy for 2,350 calories was fixed at Rs. 948.47 per adult per month in 2005–06 (GOP 2010). In the current (2011) exchange rate, Rs. 948.47 per adult per month translates to 52USCents per adult per day. On this basis, the government has determined the minimum wage at Rs. 7,000 a month. Experts claim that the cost of 2,350 calories for a typical family of six in Pakistan runs into Rs. 14,500 per month, which is twice as high as the government-determined minimum wage of Rs. 7,000 (Khabarnak, April 3, 2011). As well, the government of Pakistan seems to be a victim of the same fallacy about the “availability” of food as proponents of the growth approach. The government assumes if 2,350 calories of food per adult per day is “available” in the country, then the country is free of hunger. The government, however, does not bother itself with the question of whether or not the working and lower-middle classes can buy the “available” food, which is an issue of “food affordability.”

Table 4
% of Poverty in Rural Punjab (Pakistan)

Region	1992-93	1993-94	1996-97	1998-99	2001-02
North Punjab	10.49	29.27	21.44	29.31	25.9
Central Punjab	27.94	31.6	26.17	34.52	41.3
South Punjab	33.24	41.08	32.87	39.74	53

Source: ADB 2006.

The unwavering faith in “food availability” as a harbinger of ending hunger is grounded in the growth approach and its assumption that the rising tide of growth alone can wash away the stain of poverty. As Table 4 above shows, the most prosperous region with the highest growth rate in Pakistan is the hardest hit by poverty. Pakistan’s agricultural hinterland is the Punjab, where more than 55% of the

national population lives (Population Census Organization 2011). It is divided into three major agroecological regions of northern Punjab, central Punjab and southern Punjab. Northern Punjab is largely arid and hilly terrain, where dryland agriculture is the most common feature. Central Punjab, by contrast, is marked by industrial development with the largest working class base. Southern Punjab is agriculturally most prosperous, where farming is 100% irrigated. It features Pakistan's major crops – cotton and wheat.

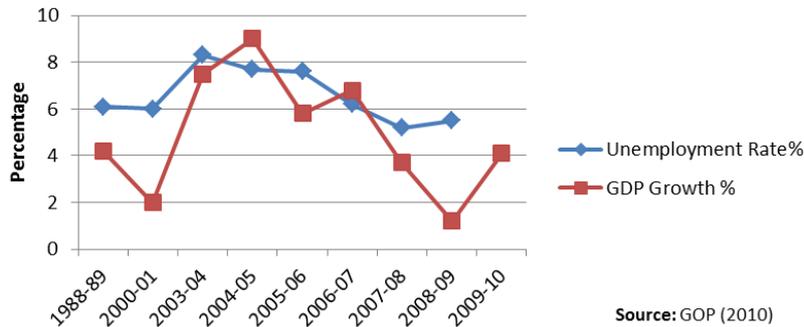
Yet the level of poverty in southern Punjab is highest of all regions. As Table 4 shows, in 1992–93, poverty in southern Punjab was more than three times that of northern Punjab. In 2001–02, it was still more than twice as high as in northern Punjab. The lower-level of poverty in northern Punjab owes itself to off-farm jobs, especially military services, which its inhabitants pursue to make a living. Southern Punjab, on the other hand, persists in poverty despite being the agricultural heartland of Pakistan and despite its remarkable contribution to the country's GDP. A comparative look at these two regions is quite instructive. In northern Punjab, the poverty rate increased from 10.49% in 1992–93 to 25.90% in 2001–02. For southern Punjab, it increased from 33.24% in 1992–93 to 53% in 2001–02. Between 1992–93 and 2001–02, poverty in southern Punjab has been consistently on an upward trajectory except for 1996–97, when it registered an insignificant drop of 1/3rd of a percentage point.

GDP Growth and Unemployment

Proponents of the growth approach have long argued that the rising tide of GDP is the ultimate antidote to poverty and hunger as it generates employment. Developing countries such as Pakistan have been religiously following this dictum to end poverty. As has been shown above, Pakistan has achieved remarkable growth in farm, food and national economies, which is assumed to end poverty by way of employment generation. The empirical reality of Pakistan, however, does not coincide with this assumption. As Figure 1 shows, there is little or no relationship between GDP growth and reduction in the unemployment rate.

Instead, the unemployment rate remains undented despite rising GDP growth. In 1988–89, GDP growth was 4.2%, while the unemployment rate was hitting at 6.1%. In 2008–09, GDP growth dropped to 1.2%, yet the unemployment rate, instead of rising, slid to 5.5%. In 2004–05, the GDP growth rate was at its highest at 9%, while the unemployment rate, instead of falling, was highest at 7.7% for the entire decade. A year after, in 2005–06, GDP growth dropped to 5.5%, while the unemployment rate, instead of rising, stood almost

Figure 1. Relationship between Economic Growth and Unemployment Rate



unchanged at 7.6% (registering only a drop of 1/10th of a percentage point). Contrary to common economic assumption, the reality of Pakistan shows a disjuncture between growth and employment. The picture of unemployment has been worse in the entire rural hinterland of Pakistan, beyond the prosperous Punjab. The country-wide rural unemployment was caused by depeasantization, a process in which large holders retrieve land from tenant-farmers into self-cultivation. As such, depeasantization contradicts the rosier assumptions of the early generations of green revolution enthusiasts, who were forecasting labor shortages in the areas of its adoption (Brown 1970, Mellor 1970).

Depeasantization and Vertical Accumulation

Depeasantization was triggered by vertical accumulation of rural assets, especially farmland. Industrial farming was at the core of this phenomenon. It led to ever more concentration of land in ever fewer hands, which defeated the purpose of even faint attempts at land reforms in 1958, 1972 and 1977. Contrarians, however, argue that the green revolution was embraced to preempt land redistribution in the fond hope that the abundant supply of food would feed the hungry, and hush the calls for land redistribution. Instead, the green revolution speeded up the vertical accumulation of farmland. The resultant landlessness further deepened rural poverty. According to the UNDP (2003a), 65% of Pakistan's population lives on \$2 a day or less. The green revolution exacerbated the pre-existing skewed distribution of land by enabling large landholders to systematically dispossess small and subsistence farmers, and retrieve the land from tenant farmers for self-cultivation (Kuhnen 1996). As a result, landownership and landholding concentration got ever worse. Kuhnen (1990) calculated

the Gini Coefficients (0 = perfect equality and 1 = perfect inequality) for landownership and landholdings in Pakistan at 0.79 and 0.63 respectively.

Table 5
Displacement of Small and Tenant Farmers and Shift in
Farm-ownership: 1960s-2000

Census Years	Number of Farms (millions)				Farm Area in million acres			
	Total	Owner farmed	Owner tenant farmed	Tenant farmed	Total	Owner farmers (millions)	Owner tenant farmers (millions)	Tenant farmers (millions)
1960	4.85	1.99	0.83	2.02	48.92	18.72	11.01	19.19
1972	3.76	1.56	0.89	1.29	49.05	19.39	15.16	14.5
1980	4.07	2.27	0.78	1.05	47.09	24.53	12.39	10.16
1990	5.071	3.491	0.626	0.954	47.31	30.72	8.99	7.61
2000	6.62	5.135	0.559	0.926	50.425	36.97	7.323	6.133

Sources: Agricultural Censuses of 1990; Agricultural Census of 2000

As Table 5 above shows, depeasantization and vertical accumulation of land assets have been simultaneously trending up since the beginning of the green revolution. The number of tenant farmers dropped from 19.9 million in 1960 to 6.13 million in 2000. On the other hand, the number of owner-farmers more than doubled from 18.72 million in 1960 to 36.97 million in 2000. Similarly, tenant-operated farms fell from 2.02 million in 1960 to 0.92 million in 2000. As a result, half of rural Pakistan (52.5 million rural residents) is now landless (World Bank 2002). As many as 40% (21 million) of the landless masses live in absolute poverty. A recent World Bank report put the number of rural poor at 35 million (Sabzwari 2007), which represents an increase of 14 million over its last assessment in 2002. The vertical accumulation is so steep that 5% of rural elites own 95% of rural assets, while 95% of rural residents get by on the remaining 5% (Niazi 2006).

Kuhnen (1996) attributes these trends, particularly land asset accumulation, to the green revolution. Since Pakistan still remains an agrarian society, where agriculture drives manufacture and service sectors, vertical accumulation ripples through businesses and industries as well. It is no coincidence that Pakistan's richest man is a textile tycoon and the textile sector is the richest of all other economic sectors. This concentration of riches in individuals and a single sector of the economy entail perverse ways, such as tax evasion and off-shore bank accounts, to drive accumulation upward. A telling illustration of

this perversity is the business community's wealth of \$200 billion that is stashed in foreign bank accounts (Capital Talk, June 3, 2011), an amount that almost equals Pakistan's national economy of \$210 billion in 2011 (GOP 2011). Pakistan's top tax attorneys suspect that most of this money is tainted and cannot be accounted for as lawful assets (Aaj Kamran Khan Kay Saath, June 16, 2011). Owners of this wealth consist of an assortment of bureaucrats, businesses, landlords, politicians and people of influence.

V. DISCUSSION AND CONCLUSION

Pakistan is set to leap into the Gene Revolution (i.e., genetic manipulation of food and cash crops) and corporate farming to bring about social amelioration. The green revolution was launched with the same promise. It is, therefore, pertinent to have a dispassionate analysis of all the hype about agricultural biotechnologies and their growth orientation, (see e.g., Bailey 2000, Borlaug and Doswell 2001, Borlaug 2000, FAO 2004). Taking a rear end view of growth and growth technologies, this analysis reminds that the green revolution was ushered in to end hunger in Asia and Latin America (Borlaug 1972, Lionaes 1972). Many have since hung high hopes on it for the generation of mass employment (Barker and Hardt 1984, Brown, 1970, Sharma and Poleman 1993), lessening of rural immiseration (Black 1960, Borlaug 2000, Borlaug and Doswell 2001, Hazell and Ramaswamy 1991, Lipton and Longhurst 1989, Sharma and Poleman 1993), and even reduction of income disparities (David and Otuska 1994, Fan 2000, Hazell and Fan 1998, Lionaes 1972). Evidence, however, points to the contrary, highlighting a major disconnect between growth assumptions and empirical realities. Pakistan, which Dr. Borlaug, founder of the green revolution, showcased as his success story, shows that privation exists in the midst of plenty, with little or no impact of growth and growth technologies on social amelioration as anticipated.

Hunger, malnutrition and underconsumption in Pakistan have rather increased to the extent that, according to the government's own assessment, 58% of its population lived on the verge of malnutrition in 2010 (Dawn, June 2, 2010). The hardest hit areas are the prime sites of the green revolution – southern Punjab and the Sind province, which together constitute the breadbasket of Pakistan. Yet almost one-fourth of the population in Sind, which is the second most populous province after the Punjab, was found malnourished. The increasing specter of malnutrition has its tropes in underconsumption as hike in food prices puts food out of the reach of millions of consumers. According to the

Asian Development Bank, 10% increase in food prices pushes 3.47 million people below the poverty line of \$1.25 a day (cited in GOP 2011). Malnutrition, food inflation and poverty are, thus, united in a symbiosis, feeding off one another. Ironically, and contrary to growth assumptions, poverty hit hardest the residents of southern Punjab, which in terms of agricultural production is the most prosperous region. The poverty rate in this region has been consistently on an upward trajectory, increasing from 33.24% in 1992–93 to 53% in 2001–02 (see Table 4).

Economists assume that growth is the ultimate antidote to poverty. With this assumption, they advance a convergence of growth and employment in that growth cuts into poverty by generating mass employment. The case of Pakistan, however, offers a divergence between growth and employment, with negligible impact of the former on the latter. The highest rate of growth in Pakistan, instead, coincides with the highest rate of unemployment (see Figure 1). Ironically, when growth drops, the unemployment rate still remains unchanged. Rural Pakistan, where the green revolution began, is worst affected by the disjuncture between growth and employment, and growth and poverty. Contrary to the initial predictions that the green revolution was a way out of rural poverty (Brown 1970) and the euphoria that it would create labor shortages in areas of its adoption (Mellor 1970), rural Pakistan rather exhibited the highest rates of poverty and unemployment in the country.

Poverty and unemployment in the rural hinterland were spurred by the twin phenomenon of depeasantization (see Table 5) and vertical accumulation of productive assets, which each were enabled by the green revolution (Kuhnen 1996, Niazi 2004) and its allied technologies. The vertical accumulation of productive assets can be observed in the Gini Coefficients for landownership and landholdings, which are as skewed as 0.79 and 0.63 respectively (Kuhnen 1990). The parallel trends in depeasantization tend to confirm the ever-worsening skewed land distribution. As Table 5 shows, the number of tenant farmers dropped from 19.9 m in 1960 to 6.13 m in 2000. The number of owner-farmers, on the other hand, more than doubled from 18.72 m in 1960 to 36.97 m in 2000. Landlessness matters because it translates into immiseration. According to the World Bank (2002), half of rural Pakistan (52 m rural residents) is without land, 40% (21m) of whom live in absolute poverty. A subsequent World Bank report (Sabzwari 2007) put the number of rural poor at 35m, which represents an increase of 14m over its 2002 assessment.

It must be noted that agricultural biotechnologies are not immune to the law of diminishing returns either, as is evident in the erosion of Pakistan's productive resources. For the five decades since

the green revolution, Pakistan's ecological base of agriculture has been steadily depleting. This depletion shows up in a consistent decline in the rate of agricultural growth that dropped from its peak of an annual average of 5.44% for the 1980s to 3.2% for the 2000s (see Table 3). Green revolution technologies (such as inorganic fertilizer, synthetic pesticides, artificial irrigation, farm mechanization), which are eating away at the country's productive land base, largely account for the declining rate of agricultural growth (Niazi 2006). In parallel, poverty and unemployment have worsened as vertical accumulation of agricultural assets led to the further unequal distribution of key productive resources, mass immiseration and depeasantization.

The vertical accumulation of productive resources and depeasantization, resulting from growth technologies, constitute the structural impediments that help perpetuate hunger, malnutrition, poverty and unemployment. Pakistan's leap into the Gene Revolution and corporate farming will further entrench these impediments. Without addressing structural barriers, agricultural biotechnologies, just like the green revolution in the past, will fail to end hunger or relieve poverty. Inversely, corporate farming and genetically altered food will likely cause massive proletarianization of peasant farmers and a range of unforeseen health issues. Nor will the dividends of corporate farming or the Gene Revolution trickle down to the lower reaches of the population any more than those of the green revolution. Yet both the planned Gene Revolution and corporate farming are already being touted as the ingenious initiatives that would make "further land reforms" irrelevant (Ahmed 2003). As long as structural impediments in skewed distribution of key productive resources remain in place, and the purchasing power of rural residents remains drained, the advanced generation of agricultural biotechnologies alone will not end hunger or relieve poverty. In order for the poor to help themselves out of poverty, distributional inequities in landownership have to be aggressively addressed and a state-initiated entitlement program for the impoverished rural masses, as persuasively argued by Sen (1982), has to be structured. The latter becomes even more urgent in the face of distributional inequalities that continue to worsen by the day.

NOTE

- * The author dedicates this paper to the cherished memory of his benefactor, friend and mentor, late Dr. William R. Freudenburg, a co-founder of Environmental Sociology.

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